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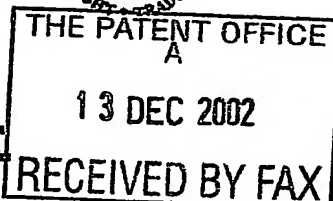
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3. Full name, address and postcode of the or of each applicant (underline all surnames)	INCRO LIMITED 35 Fairfield Rise Wollaston Stourbridge West Midlands DY8 3PQ United Kingdom		
Patents ADP number (if you know it)	130EC02 E770901-1 D02802 P01/7700 0.00-0229099.7		
If the applicant is a corporate body, give the country/state of its incorporation	6463632001 ID		
4. Title of the invention	PUMP-ACTION NOZZLE DEVICE		
5. Name of your agent (if you have one)	WILSON GUNN SKERRETT CHARLES HOUSE 148/3 GREAT CHARLES STREET BIRMINGHAM B3 3HT UNITED KINGDOM		
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PUMP-ACTION NOZZLE DEVICE

The present invention relates to a pump-action nozzle device. More particularly, the present invention relates to a pump-action nozzle device adapted to be fitted to the opening of a container to provide a means by which
5 the contents stored therein can be dispensed through the opening of the container. It shall be understood that the term "pump-action" is used herein to refer to nozzle devices which contain a manually operable pump, the operation of which causes the contents stored in the container to which the device is fitted to be dispensed through a nozzle outlet under pressure.

10 Conventional pump-action nozzle devices fall within two general categories, namely the so-called trigger nozzle devices and the so-called pump nozzle devices. The former category includes devices where the pump-action is mediated by pulling and then releasing a trigger provided as a component of the device, whereas the latter category includes devices where the pump-action is
15 mediated by an operator directly pressing and then releasing a resiliently mounted portion of the nozzle device. Pump nozzle devices are also commonly referred to as finger pumps because they are adapted to enable the operator to operate the device with their finger. In both cases, the operation of the trigger or the pump generates a pressure within the device which forces a proportion of
20 the contents of the container to which the device is attached to be dispensed through a nozzle outlet of the device.

Although such devices provide a convenient means by a products stored in a container can be dispensed, there are a number of problems associated with conventional pump-action nozzle devices. Firstly, the conventional devices tend to be extremely complex in design and often comprise numerous different components (on average, 12 individual components in pump nozzle devices and between 10 and 14 individual components in trigger nozzle devices). As a consequence, these devices are costly to manufacture due to the amount of material required and the assembly processes involved. Secondly, the conventional devices tend to be bulky, which again contributes to the cost constraint arising as a consequence of the amount of material that is required to manufacture the device. Thirdly, a proportion of the bulk of the conventional pump devices resides inside the container to which the device is attached. This creates a drawback in that the nozzle device takes up a proportion of the internal volume of the container, which can be a particular problem in small containers. Finally, the size of the pump device is also restricted in small containers with narrow necks and this limits the amount of pressure that can be generated by the device, which can again be detrimental to the performance of the device. One solution to this latter problem is to increase the height of the pump nozzle device, but with small containers this creates further problems in that, in addition to being unsightly, it becomes difficult for an operator to hold the container in their hand and also operate the pump with their finger.

Therefore, there is a desire for a pump-action nozzle device which is simpler in design, utilises less components and is generally less bulky than the conventional pump-action nozzle devices.

The present invention seeks to address the aforementioned problems associated with conventional pump-action nozzle devices by providing, in a first aspect, a pump-action nozzle device adapted to be fitted to an opening of a container and enable the contents stored in said container to be dispensed through said opening, said device comprising:

- (i) a base;
- 10 (ii) a housing mounted to said base, said housing defining an internal chamber together with said base and further comprising a nozzle outlet;
- (iii) a first valve disposed between said chamber and the interior of the chamber to which the device is fitted;
- 15 (iv) a second valve disposed between the chamber and the nozzle outlet defined by said housing;

said device being operable in a first stage of operation to cause the contents of said container to be drawn into the chamber of the device from the interior of the container to which it is fitted through said first valve, and, in a second stage
20 of operation, to cause the contents of the chamber to be ejected from said

device by causing said contents to flow through said second into the nozzle outlet;

wherein said first stage of operation is facilitated by the movement of said housing relative to the base so as to cause the internal volume of said chamber to expand, thereby creating a reduced pressure within said chamber relative to the interior of the container which causes the second valve to close and the first valve to open and the contents of said container to flow from the container into the chamber, and said second stage of operation is facilitated by the movement of the housing relative to base so as to cause the chamber to be compressed, thereby increasing the pressure within the chamber relative to the external environment of the device and causing the first valve to close and the second valve to open and the contents of said chamber to be dispensed from the chamber and through the nozzle outlet.

When compared to conventional pump-action nozzle devices, the devices of the present invention are simpler in design/construction and comprise a reduced number of components. This provides significant cost savings by reducing the amount material required to manufacture the devices, as well as reducing the construction/assembly costs. Furthermore, in preferred embodiments of the invention, the bulk of the device can be significantly reduced and the chamber can be positioned outside the container, thereby enabling the device to be fitted to the openings of containers of virtually any size, without the amount of pressure that can be generated being influenced by

the size of the container and the constraints that this would impose of the dimensions of the device (as is the case with conventional pump nozzle devices).

The housing of the device may be one integrally formed component or, alternatively, may be formed of multiple component parts that are fitted together to form the housing. Preferably the housing comprises two parts. Most preferably, the housing comprises a main body part and a lid which is fitted to the housing and, together with the main body of the housing, forms the second valve and the nozzle outlet.

Preferably, the housing is slidably mounted within a recess formed in an upper surface of the base to enable the housing to be moved relative to the base to vary the internal volume of the chamber during the operation of the first and second stages of operation of the device.

Preferably, the chamber of the device further comprises a plunger. The function of the plunger is primarily to enable virtually the entire contents of the chamber to be expelled during the second stage of the operation of the device of the invention. To enable the plunger to perform this function it must form a seal with the sides of the chamber formed by the internal walls of the housing. Preferably, the plunger forms two seals with the wall of the chamber, namely a first seal which prevents the product leaking past the plunger during the second stage of operation and a second seal which prevents air being drawn into the

chamber (instead of the contents of the container) during the first stage of operation of the device. Furthermore, the sealing contact or contacts must be maintained while the housing is moved relative to the base to facilitate the expansion and/or compression of the chamber. The plunger may be fixed to the

5 housing within the chamber so that when the housing moves relative to the base during the operation the device, the plunger also moves. Preferably, however, the plunger is seated on an upper surface of the base of the device so that the space within the chamber is defined between said plunger and the internal walls of the housing. In addition, it will be appreciated that the plunger will remain

10 in this position within the chamber as the housing is moved relative to the base during the operation of the device. The plunger may be made from any suitable material, such as rubber or plastics materials, for example. The plunger may be integrally formed with the base, but is preferably a separate component formed of a different material to that of the base.

15 The base is preferably adapted to enable the device to be fitted to an opening of a container. In a preferred embodiment, the base comprises a cavity adapted to receive a correspondingly neck of the container which defines the opening of the container. The neck may be secured in the cavity by any suitable securing means. Preferably, the base is a screw top which can be fitted to an

20 opening of the container (i.e. the neck of the container is provided with a screw thread that is adapted to screw into a groove formed in the internal wall of the base, or vice versa).

The first valve may be any suitable valve assembly which enables the contents of the container to flow into the chamber of the device during the first stage of operation of the device, but which prevents flow in the other direction during the second stage of operation of the device. In certain embodiments of the invention, the plunger is seated on the upper surface of the base and comprises valve member or stem which extends downwards from the main body of the plunger and is received in a sealing engagement with a valve seat formed in the base. In alternative embodiments, the valve member or stem may be a separate components, i.e. it is not integrally formed with the plunger.

10 During the first stage of operation, the valve member or stem is displaced from the valve seat to form an opening through which the contents of the container may flow into the chamber of the device.

The second valve between the chamber and the nozzle outlet may also be any suitable valve assembly which opens when the contents of the chamber are compressed during the second stage of the operation of the device, but which closes during the first stage of operation to prevent air being drawn into the chamber through the nozzle outlet. Preferably, the second valve requires the minimum threshold pressure to be attained within the chamber before the valve will open. For example, the contents of the chamber may be ejected at a pressure of 6 bars and in such cases the second valve may be provided with a minimum threshold pressure of 5 bars. The second valve could be a ball valve, for example, where the ball is displaced to open the valve when the pressure

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within the chamber exceeds a predetermined minimum threshold. In a preferred embodiment of the invention, however, the second valve is a flap valve in which the flap is resiliently mounted so as to reside in a position in which a channel between the chamber and nozzle outlet is closed (i.e. the valve is closed), but may be distended to a position in which said channel is open (i.e. the valve is open) when the pressure within the chamber exceeds a predetermined maximum.

In an especially preferred embodiment, the second valve comprises a channel opening between the chamber and the nozzle outlet which is closed by a resiliently deformable membrane. The resiliently deformable membrane may be made from any suitable resiliently deformable material, such as plastic or rubber. The membrane is configured so that it covers the opening formed in the wall of the chamber and will only deform to form an opening between the chamber and the nozzle outlet when the pressure within the chamber exceeds a predetermined minimum threshold. In preferred embodiments, the resiliently deformable membrane is formed in a lid which is fitted to, and forms a constituent part of, the housing.

Any suitable nozzle outlet may be used in the devices of the present invention. In particular, the nozzle outlet may be adapted to generate a spray of the contents of the container passing through it or, alternatively, it may be an outlet channel through which more viscous fluids, such as soaps, creams and mousses etc. may be dispensed.

Preferably, the nozzle outlet is formed from two parts, each respective part having an abutment surface having recesses or grooves formed therein which, when the abutment surfaces are brought into contact with one another, define an inlet, an outlet and a fluid flow passageway which connects said inlet to said outlet. The respective parts, once formed, may be permanently fixed together by, for example, ultrasonic welding, or alternatively, the parts may be releasably connectable to one another. This latter form of assembly is preferred because it enables the respective parts to be separated to expose the inlet, outlet and fluid flow passageway of the nozzle outlet for cleaning.

10 Preferably, one of the parts is the main body of the housing of the device and the other (second) part may be in the form of lid or cap which is fitted to the housing and together with the main body of the housing form the nozzle outlet thereof. In certain embodiments of the invention, the second part may also form the resiliently deformable membrane of the second valve, as
15 mentioned above. Examples of nozzle arrangements formed of two separate parts are described in WO 01/89958 and WO 97/31841, and the entire contents of these documents are incorporated herein by reference.

In order to prevent the container collapsing as the device of the present invention is used, it is preferable that the device comprises an air leak valve, to
20 enable air in the external environment to access the interior of the container to equalise any pressure differential that exists between them. Any suitable form of air leak would suffice. Preferably, however, the air leak valve is a one-way

valve, which enables air to flow into the container from the outside, but prevents flow in the opposite direction and hence, prevents any product in the container from leaking out through the air leak valve if the container is inverted, for example. Illustrative examples of suitable air leak valve
5 arrangements formed in the device of the present invention are described below in reference to Figures 9A, 9B and 9C.

Preferably, the device further comprises resilient means disposed between the base and the housing. The resilient means preferably acts to urge the housing and the base apart, i.e. into a position in which the internal volume
10 of the chamber is expanded to, or nearly to, its maximum. Preferably, the resilient means is a spring disposed within the chamber that is biased at one end against the base and, at the other end, against the housing of the device.

In use, an operator wishing to dispense the contents of the container can apply pressure to the housing of the device against the action of the spring and
15 thus, cause chamber defined therebetween to compress and the contents of the chamber to be dispensed through the nozzle outlet. Once the pressure applied by the operator to the housing has been released, the spring urges the housing and the base apart and thus causes the contents of the container to be drawn into the chamber of the device ready for the next actuation by the operator.

20 Preferably, a dip tube is fitted to the base to enable a product stored in the container to be drawn into the device from the interior of the container.

For certain applications, it is desirable to co-eject air together with the contents of the container passing through the nozzle outlet. For instance, the air could be mixed with the product to impart a certain consistency to the product, as is the case with certain foams or mousse products for example, or an air stream could be used to atomise droplets of fluid passing through the nozzle outlet. For this latter application it is especially desirable to be able to introduce an air stream at a predetermined location along the length of the fluid flow passage of the nozzle outlet. Hence, in certain embodiments, the chamber of the device is divided into two separate compartments, a first compartment which is provided with the first and second valves to enable the contents of the container to be drawn into the first compartment and dispensed through the nozzle outlet during the respective first and second stages of operation, and a second compartment which is a separate air compartment. Hence, the movement of the housing relative to the base to cause the compression of the chamber during the second stage of operation in such embodiments causes the contents of the container to be dispensed through the nozzle outlet in the usual manner, but also forces air from the second compartment through an outlet channel into the nozzle outlet, where the mixing of the air with the contents of the container passing through the nozzle outlet occurs. In a preferred embodiment, the nozzle outlet has a fluid flow passage which is separated from the fluid flow passage by a wall and the outlet channel is a hole formed in said wall between the chamber and the fluid flow passage. In certain embodiments,

the outlet channel may be provided with a valve which functions in a similar manner to the second valve discussed above.

Preferably, during the first stage of operation of the device, air is drawn into the air chamber from the external environment through a one-way air inlet valve which allows air to access the air compartment of chamber when the pressure in the chamber is decreased relative to that of the external environment, i.e. when the volume of the chamber is increased by moving the housing and the base apart, but prevents the flow of flow in the opposite direction during the second mode of operation. The air may be drawn into the air compartment through the nozzle outlet and/or through gaps formed between the housing and the base through which the air may flow.

Preferably, the first compartment comprises a plunger as discussed above and the second air compartment is also provided with an air plunger. Preferably, the air plunger is adapted to form a seal with the housing which prevents the air present in the air compartment from leaking past the air plunger during the second stage of operation, but which allows air to flow past during the first stage of operation.

In a preferred embodiment, the air inlet valve also functions as the air release between the interior of the chamber and the external environment.

The device of the present invention may also be provided with a trigger actuator which enables the first and second stages of operation to be facilitated

by the operation of a trigger, rather than applying pressure to the housing directly. The trigger actuator is preferably configured so that, when the trigger is pulled, the housing of the device is caused to move relative to the base and compress the chamber of the device, thereby causing the contents stored therein
5 to be dispensed through the nozzle outlet, whereas when the trigger is released the housing is caused to move relative to the base so as to cause the volume of the chamber to expand and thereby draw more product (and air if an air compartment is present) into the chamber.

Preferably, the trigger actuator is a separate component that is fitted to
10 the pump-action nozzle device and which comprises a trigger and a mounting. Preferably, the mounting is fixed to the base by one attachment element and the housing by another attachment element and is configured so that when the trigger is pulled the two attachment elements are brought closer together and when the trigger is released, the two attachment elements move further apart.
15 Hence, when the trigger is pulled, the housing is caused to move towards the base and thus compresses the chamber causing the contents of the chamber to be dispensed, whereas when the trigger is released, the housing returns to its original position and the volume of the chamber expands. Preferably, one attachment element is integrally formed with the trigger and is pivotally
20 attached to the base of the device and the other attachment element, the other attachment element being pivotally mounted to the housing of the device.

According to a second aspect of the present invention there is provided a trigger actuator adapted to be fitted to a pump nozzle device comprising an internally compressible chamber formed between a housing and a base of the device, said housing being moveable relative to the base to facilitate the expansion of the internal chamber in a first stage of operation and the compression of the chamber in a second stage of operation, said trigger actuator comprising a trigger and means by which the trigger actuator may be connected to the base and means by which the trigger actuator may be attached the housing, wherein said trigger actuator is configured so that when the trigger is pulled towards the nozzle device said housing is caused to move relative to the base and compress the chamber during the second stage of operation and when said trigger is released said housing is caused to move relative to the base to expand the chamber during the first stage of operation.

Thus, the trigger actuator provides a means by which a pump nozzle device may be converted into a trigger actuated pump-action nozzle device.

The trigger actuator is preferably formed as discussed above, i.e. it comprises a manually operable trigger that is connected to the base of the nozzle device by an attachment element and the housing by another attachment element, said elements being moveable towards each other when the trigger is pulled and moveable apart from each other when the trigger is returned to its original position. Preferably, the housing is resiliently mounted to the base so

that the trigger returns to its original "non-actuated or pulled" position automatically when it is released.

How the invention may be put into effect will now be described further by way of example only in reference to the following Figures, in which:

5 Figure 1A is a cross-sectional view taken through a first embodiment of a device of the present invention;

Figure 1B is an exploded cross-sectional view showing the components which make up the device shown in Figure 1A;

Figure 2A is a cross-sectional view taken through a second embodiment
10 of a device of the present invention;

Figure 2B is an exploded cross-sectional view showing the components which make up the device shown in Figure 2A;

Figure 3A is a cross-sectional view of the housing 102 shown in Figures 2A and 2B;

15 Figure 3B is a plan view of the underside of the housing 102 shown in Figures 2A and 2B;

Figure 4 is a plan view of the base 101 shown in Figure 2A;

Figure 5A is a cross-sectional view of the plunger 108 shown in Figures 2A and 2B;

20 Figure 5B is a plan view of the plunger 108 shown in Figures 2A and

2B;

Figures 6A and 6B are both cross-sectional views showing the top portion of the housing shown in Figure 2A and 2B nozzle outlet with the lid 104 partly displaced from the housing (Figure 6A) and in contact with the
5 housing 102 (Figure 6B);

Figure 7A is a cross-sectional view of the nozzle outlet 106 shown in Figures 2A and 2B;

Figure 7B is a perspective view of the recess 704 shown in Figure 7A;

Figure 7C is a cross-sectional view taken along line X-X' of Figure 7A
10 in an assembled nozzle outlet;

Figure 8 is a cross-sectional diagrammatical view taken through the upper portion of the housing 102 of an alternative embodiment of the present invention which incorporates an alternative version of the second valve;

Figure 9A is a cross-sectional diagrammatical view showing a portion of
15 an embodiment of a device of the present invention comprising an air leak;

Figure 9B is a cross-sectional diagrammatical view showing a portion of an alternative embodiment of a device of the present invention comprising an air leak;

Figure 9C is a cross-sectional diagrammatical view showing a portion of
20 an alternative embodiment of a device of the present invention comprising an

air leak;

Figure 10A is a cross-sectional view of a device of the present invention which is fitted with a trigger actuator; and

Figure 10B is a cross-sectional view of the device shown in Figure 8A
5 when the trigger has been pulled to cause the housing to move relative to the base.

In the following description of the Figures, like reference numerals will be used to denote like or corresponding parts in different Figures.

A first embodiment of a device 100 according to the present invention is
10 shown in Figures 1A and 1B. The device 100 comprises a base 101 which comprises a cavity 150 having a screw thread formed in the internal wall thereof. This internal cavity 150 is adapted to receive a corresponding shaped screw threaded neck of a container, thereby enabling the device 100 to be
screwed onto a container for use. The device further comprises a housing 102
15 which is slidably mounted within a recessed groove 103 formed on the upper surface of the base 101. The base is provided with an inwardly projecting rim 101a which abuts against an outwardly projecting rim 102a formed on the housing 102 to prevent the housing from sliding out of engagement with the
base during use and thus, limits the extent to which the housing can slide
20 upwards relative to the base.

The housing 102 defines an internal chamber 107 in which a plunger

108, which is seated on the base 101, is positioned. The plunger 108 extends across the entire width of the chamber 107 and forms a tight seal with the wall of the chamber formed by the housing 102. The plunger 108 also has an integrally formed, downwardly extending valve member 108a, which is
5 received within a valve seat 109 formed in the base 101. The valve member 108a, together with the valve seat 109, form the so-called first valve of the device between the chamber and the interior of the container. An inlet channel 110 is also formed in the base 101 and a dip tube (not shown) is fitted to this channel to enable the contents of the container to be drawn into the chamber of
10 the device through the first valve during use of the device.

The housing 102 further comprises a lid 104. The lid 104 is provided with a resiliently mounted flap 105 which fits over an outlet 105a of the chamber 107 to form the second valve. The lid 104 also has an abutment surface which is contacted with an abutment surface formed on the upper
15 surface of the housing 104. These two abutment surfaces have various recesses formed therein which, when the surfaces are contacted together define a nozzle outlet 106 of the device. The nozzle outlet 106 is discussed further below in reference to Figures 7A, 7B and 7C.

A coiled spring 111 is positioned within the chamber 107. The spring is
20 biased at one end against the housing 102 and the base 101 at its other end. The housing additionally comprises a support member 102b which extends downwards from its upper surface and is positioned inside the bore defined by

the coiled spring 111. The support member 102b provides support to the spring and also enables the spring to be kept in place while the device is assembled.

The spring forces the housing upwards relative to the base so that the
5 rim 102a of the housing abuts the internal rim 101a of the base. In this position (and as shown in Figure 1A) the internal chamber 107 is expanded to its maximum internal volume. During use, the lid 104 of the housing 102 can be pressed downwards by an operator so as to cause the housing 102 to slide relative to the base 101, against the action of the spring 111. During this
10 process, the internal volume of the chamber 107 is reduced and this in turn compresses the contents present within the chamber. The resultant increase in pressure pushes the valve member 108a of the plunger into a sealing engagement with the valve seat 109, thereby closing the first valve and preventing the contents of the chamber flowing from the chamber 107 into the
15 interior of the container. Once the pressure within the chamber reaches a predetermined minimum threshold value, for example 5 bars, the contents of the container cause the resiliently mounted flap 105 positioned over the chamber outlet 105a to be displaced from a position in which the outlet is blocked to a position in which the outlet is open, thereby enabling the contents
20 stored within the chamber 107 to flow through the second valve and then be dispensed from the device through the nozzle outlet 106.

Once the desired amount of product has been dispensed or the housing

has been depressed to its fullest extent so that the maximum quantity of product has been dispensed from the chamber; then the operator will release the pressure applied to the housing and the housing will slide back to its initial position shown in Figure 1A under the action of the spring 111. In doing so the internal volume of the chamber 107 is expanded and this creates a reduced pressure within the chamber. The second valve is closed during this process because once the pressure falls below the minimum threshold, the resiliently mounted flap 105 returns to the position in which it covers the outlet 105a. The reduced pressure within the chamber 107 causes the first valve to be opened, i.e. the valve member 108a of the plunger 108 is displaced from the valve seat 110 and the contents of the container are drawn into the chamber 107 to replenish the contents previously dispensed.

In a preferred embodiment, the plunger would be replaced with the plunger shown in Figure 9C, thereby providing the device 100 with an air leak valve.

Referring to Figure 2A and 2B, there is shown a second embodiment of a device 200 of the present invention. This second embodiment is the same as the embodiment shown in Figure 1 in many respects and this is illustrated by the use of the same reference numerals to denote like or corresponding parts. There is, however, one principal difference in that the housing 102 is formed to define a chamber 107 that is composed of two separate, internally sealed compartments. The central compartment 107a is equivalent to the chamber 107

shown in Figure 1 in that the contents of the container pass through it during the first and second stages of use previously discussed. The circular wall 201 of the housing 102 defines the central compartment 107a. This wall 201 is received within a corresponding circular recessed groove 202 formed in the upper surface of the base 101. Thus, during use the wall 201 slides within the recessed groove 202. The chamber 107a comprises a smaller plunger 108 and a spring 111, the functions of which are identical to that described in reference to Figures 1A and 1B.

The second compartment defined by the housing 102 is an air compartment 203 which surrounds the central compartment 107a. The air compartment 203 is defined between the outside wall of the housing 102 and the inner wall 201. An air plunger 204 is seated on the base within the air compartment 203 and performs the same function as the plunger 108 describe in reference to Figure 1. In this embodiment, the air plunger 204 is circular and comprises a recess 205 formed in its under surface which, when seated onto the base in the final assembly, as shown in Figure 2A, receives the upright protrusion 206 formed on the base. A plan view of the upper surface of the base 101 is shown in Figure 4 to illustrate the arrangement of the respective recesses and protrusions.

In alternative embodiments of the invention, the housing 102 may be wider than the base and configured so that the outer wall of the housing slides over the outer wall of the base. This construction is preferred for embodiments

of the invention which comprise an air leak, as discussed further below in reference to Figure 9C.

For the purpose of illustration, housing 102 of the embodiment shown in Figure 2 is shown in Figures 3A and 3B. Referring to these Figures, it can be
5 seen that the housing has two outlets formed in its upper surface, namely a channel 301 through which the contents of the container to which the device is attached flow into the opening 105a during use, and a channel 302 through which the contents of the air compartment 203 are ejected during use into the nozzle outlet defined between the lid 104 and the upper surface of the housing
10 102.

The plunger 108 of the embodiment shown in Figures 2A and 2B is shown in more detail in Figures 5A and 5B. The upper portion of the plunger 108 is shaped to form two tight sealing engagements with the wall 201 of the central chamber 107a when positioned within the assembled device, as shown
15 in Figure 2A. Specifically, a first seal, which prevents air leaking past the plunger during the second stage of operation, is formed by the edge 501 contacting the wall of the housing 201. A second seal, which prevents air leaking past the plunger during the first stage of operation, is formed by the contact of the edge 502 with the housing 201. If the second seal was not
20 present, the edge 501 could be displaced from contact with the housing during the first stage of operation of the device by the pressure difference between the interior of the compartment and the outside environment, thereby causing air to

flow into the compartment 107a, instead of product being drawing in through the first valve. The plunger also has a downwardly extending valve member 108a in the form of a truncated cone which is received within the aperture defined by the valve seat 109 of the base 101 to form the first valve.

5 The upper portion of the housing 102 is shown in more detail in Figures 6A and 6B. Fitted to the upper part of the housing 102 is a lid 104. The lid is composed of two parts, a body 601 which is adapted to be fitted to the upper portion of the housing 102 and a hinged lid portion 602. The hinged lid portion 602 has the resiliently deformable flap 105 formed on its under surface which, 10 when the lid is brought together with the body 601, forms the second valve, as discussed previously. The hinged lid portion 602 also has an abutment surface having grooves and/or recesses formed thereon which, when the lid is contacted with a corresponding abutment surface formed on the upper surface of the housing 102 which has corresponding grooves and/or recesses formed thereon, 15 defines the nozzle outlet 106.

A plan view of abutment surface of the upper surface of the housing 102 is shown in Figure 7A. The abutment surface 701 comprises the outlet channel 301 of the housing through which fluid accesses the second valve and a groove 702 which extends from the second valve to an outlet 703. Formed within the 20 groove 702 is a deepened recess 704. The recess 704 is shown in more detail in Figure 7B where it can be seen that the recess is semicircular in cross-sectional profile and the channel 302 that extends from the air compartment of the

chamber defined by the housing to the nozzle outlet opens into this recess. The abutment surface of the lid 602 (not shown) comprises a similar groove to the groove 702 with an equivalent a recess equivalent to the recess 704 formed therein. Thus, when the two abutment surfaces are brought into contact, the

5 grooves and recesses formed therein align to form a fluid flow passageway which extends from the second valve to the outlet 703 of the device and comprises a circular chamber formed by the alignment of the recess 704 and the corresponding recess of the abutment surface of the lid 602. The chamber thus formed is known as an expansion chamber. In use, the contents of the

10 container, which is usually a fluid, passes through the second valve into the passageway formed by the groove 702 and its equivalent on the opposing abutment surface of the lid. The fluid is then sprayed into the expansion chamber (see reference 710 in Figure 7C) formed by the recess 704 and the corresponding recess in the opposing abutment surface of the lid through an

15 orifice formed in the passageway (not shown). The spray droplets thus formed mix with an air stream ejected from the air compartment in the expansion chamber and then continue along the passageway to the outlet where they are ejected from the device in the form of a spray.

To prevent the occurrence of leaks, the fluid outlet arrangement is

20 surrounded by a horseshoe-shaped recess 705 formed in the abutment surface of the housing 102 which receives a correspondingly shaped protrusion 706 (see Figure 7C) formed on the abutment surface of the lid, as shown in Figure

7C, to form a horseshoe-shaped seal barrier. In a similar manner, further recesses 707 extend from either side of the horseshoe-shaped recess 705 towards the groove 702 at various points along the length of the groove 702. These further recesses also receive correspondingly shaped protrusions on the abutment surface of the lid and, together with the horseshoe-shaped seal barrier, define a series of internally sealed compartments around portions of the fluid flow passageway when the abutment surfaces of the upper surface of the housing 102 and the lid 602 are brought into contact. Any fluid that leaks from the fluid flow passage during use is then trapped within one of these compartments and prevented from seeping between the abutment surfaces and leaking from the nozzle outlet.

The channel 302 is shown in Figures 7A and 7B as a direct channel between the air compartment 203 (not shown) and the fluid flow passage of the nozzle outlet. Where the nozzle outlet is formed between the abutment surfaces of two or more parts, as shown in Figures 7A and 7B, it shall be appreciated that the air can be conveniently channelled to virtually any point along the length of the fluid flow passage that is desired by, for example, directing the air stream along the horseshoe-shaped seal (in a channel formed between the bottom of the horseshoe-shaped recess formed in one abutment surface and the upper edge of the horseshoe-shaped protrusion formed on the opposing abutment surface and then re-directing the air stream through a channel, which is preferably formed in a similar manner to the channel in the horseshoe-shaped

seal, into the fluid flow passage. Alternatively, the air may be directed to the desired location in the nozzle outlet through a channel that is formed in a similar manner to that previously described (but without being directed along the horseshoe-shaped seal).

5 Figure 7C is a cross-sectional view taken along line X-X' of Figure 7A. In Figure 7C the horseshoe-shaped recesses 705 and the horseshoe-shaped protrusion 706, which form the horseshoe shaped seal are visible on either side of the expansion chamber 710. The fluid flow passage 711 which opens to the expansion chamber 710 is also shown.

10 An alternative embodiment of the cap 104 is shown in Figure 8. In this embodiment, the cap 104 is fitted to the upper end of the housing 102 shown in Figures 1A and 1B in the usual manner. The channel 301, through which the product flows when it is ejected from the chamber 107, is covered by a resiliently deformable membrane 801, which is integrally formed in the lid 104,
15 and has a downwardly extending post 802 which is received within the upper portion of the channel 301. This membrane effectively forms an alternative form of the second valve of the device. During use, i.e. when the housing is pushed downwards to eject the contents of the chamber through the nozzle outlet during the second stage of operation, the pressure within the chamber
20 increases to a predetermined threshold level and, once this level is attained, the membrane 801 deforms away from the channel 301 withdrawing the post 802 to form an opening through which the contents of the container may access the

nozzle outlet 106. After use, i.e. when the pressure falls below the threshold value, the membrane returns to its original position in which the channel 301 is closed, as shown in Figure 8.

Figure 9A shows a modification to the air plunger 204 and base 101 shown in Figures 2A and 2B which provides an air leak to equalise any pressure differential that develops between the interior of the container and the external environment. Only the relevant portion of the device is shown in Figure 9A for the purpose of illustration. As previously discussed in reference to Figures 2A and 2B, the housing 102 is slidably mounted in a recess 103 of the base 101 and an air plunger 204 is seated on a protrusion ridge 206 formed in the base 101. As shown in Figure 9A, the air plunger 204 is modified to include a downwardly extending resiliently mounted arm 901 which contacts the internal wall of the housing. The resiliently mounted arm 901 is positioned adjacent an air leak opening 902 formed within the base and is capable of movement between a position in which said arm covers and closes the air leak opening and a position in which the air leak is open, thereby enabling air to flow between the external environment and the interior of the container. As can be seen in Figure 9A, the resiliently mounted arm 901 of the plunger 204 can be urged into the closed position by an enlarged annular rim 903 at the base of the internal wall of the housing 101, which urges the resiliently mounted arm into a position in which the air leak is closed when the device is not in use and the housing is displaced upwards relative to the base of the spring. During the

second stage of operation when the housing is pushed downwards relative to the base, the arm 901 of the air plunger 204 tends to still seal the opening 902, whereas when the housing moves upwards relative to the base during the first stage of operation, the arm 901 is displaced from the opening 902 and air can
5 pass through the opening until the rim 903 urges the arm 901 back towards the opening to reform the seal.

Figure 9B shows yet another alternative embodiment of the device of the present invention which comprises an air leak formed therein. The embodiment shown in figure 9B is similar to that shown in Figures 2A and 2B in certain
10 respects. However, this embodiment differs in that the central compartment 107a of the chamber is provided with a plunger of different construction to the plunger 108. In this embodiment, the plunger in the central cavity 107a is shown by the reference 910 and a separate valve member 911 is received within the valve seat 109 of the base 101 to form the first valve. A ledge or set of post
15 912 onto which the spring 111 is mounted is provided between the valve member 911 and the plunger 910. A further modification is that the second valve is formed by a resiliently deformable membrane 801 having a downwardly extending member 802 which is received within the outlet channel 301, rather than the flap 105 which covers the opening 105a previously
20 described.

The air plunger 204 is also of a different form but, in common with the embodiment shown in Figure 9A, comprises a resiliently mounted arm 901

which is also capable of being urged from a position in which the arm is displaced from an air leak opening 902 formed in the base and the air leak is open, to a position in which the air leak 902 is closed. Again, the arm 901 of the air plunger 204 is urged into the position whereby the air leak 902 is closed

5 when an enlarged rim 903 formed at the base of the internal wall of the housing 102 slides past the arm 901. Hence, when the housing is pressed down relative to the base, as shown in Figure 9B, the air leak is open, but if the housing is released so that the spring 111 pushes the housing upwards until the rim 102a abuts the rim 101a, then the arm is urged into the position whereby the air leak

10 is closed by the enlarged rim 903.

Figure 9C shows a further alternative embodiment of the device, which comprises an air leak. In this embodiment, the outer wall of the housing slides over the outer surface of the base when the housing is pushed down relative to the base, rather than being slidably mounted within a recessed groove formed in

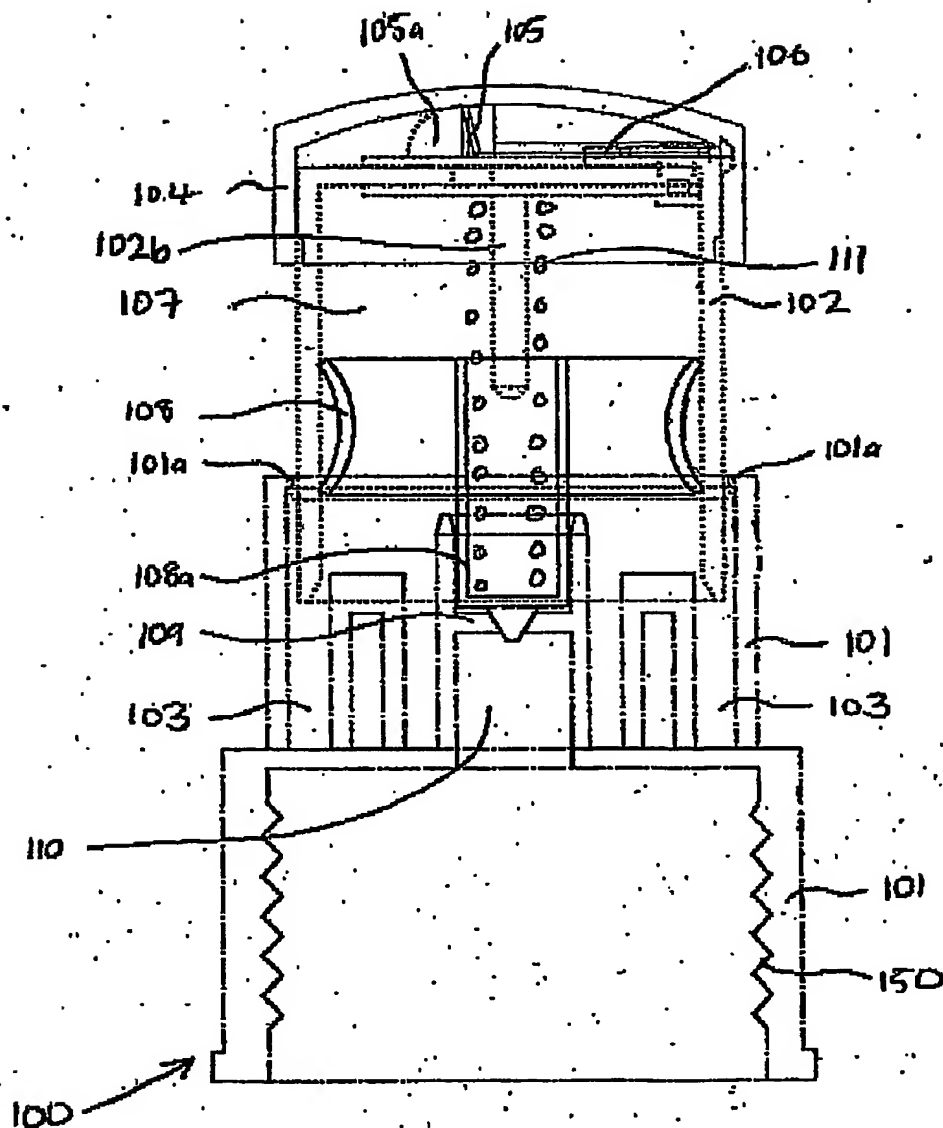
15 the upper surface of the base, as in all of the previous embodiments. In this embodiment, the air plunger 204 is in the form of a wedge which possesses two arms. A first arm 901 contacts the side of the base to form a seal to close the air leak 902 formed in the base, whereas the second arm 920 forms a tight sealing engagement with the internal wall of the air compartment 203. The seal

20 formed by the arm 901 is only very light and this arm can be deflected to a position in which the air leak is open if the external pressure exceeds the pressure within the container. The leakage of the contents of the container out

of through the air leak 902 is prevented, however, because the arm 902 forms a seal against the wall of the base as shown in Figure 9C and cannot be deflected further to enable flow to occur out of the container.

Figures 10A and 10B show a container 1000 fitted with a device 100 of the present invention which is provided with a trigger actuator 1001. The trigger actuator 1001 is composed of two pivotally connected parts 1002 and 1003 connected together by a plastic hinge at 1004. Part 1002 consists of an attachment element 1002a which is pivotally connected to the base of the device and a trigger 1002b which can be operated by a user in the normal manner. Part 1003 is pivotally mounted to the lid 104 of the housing 102. Operation of the trigger by pulling it towards the container pulls the part 1002 downwards about the pivotal connection to the base and his action causes the part 1003 to pull the housing downward relative to the base, thus compressing the chamber therein and causing the product, or a mixture of product and air, to be dispensed through the nozzle outlet. It will be appreciated that many other forms of trigger actuator could be prepared and the present invention is not to be considered limited to the specific embodiment described.

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Figure 1A

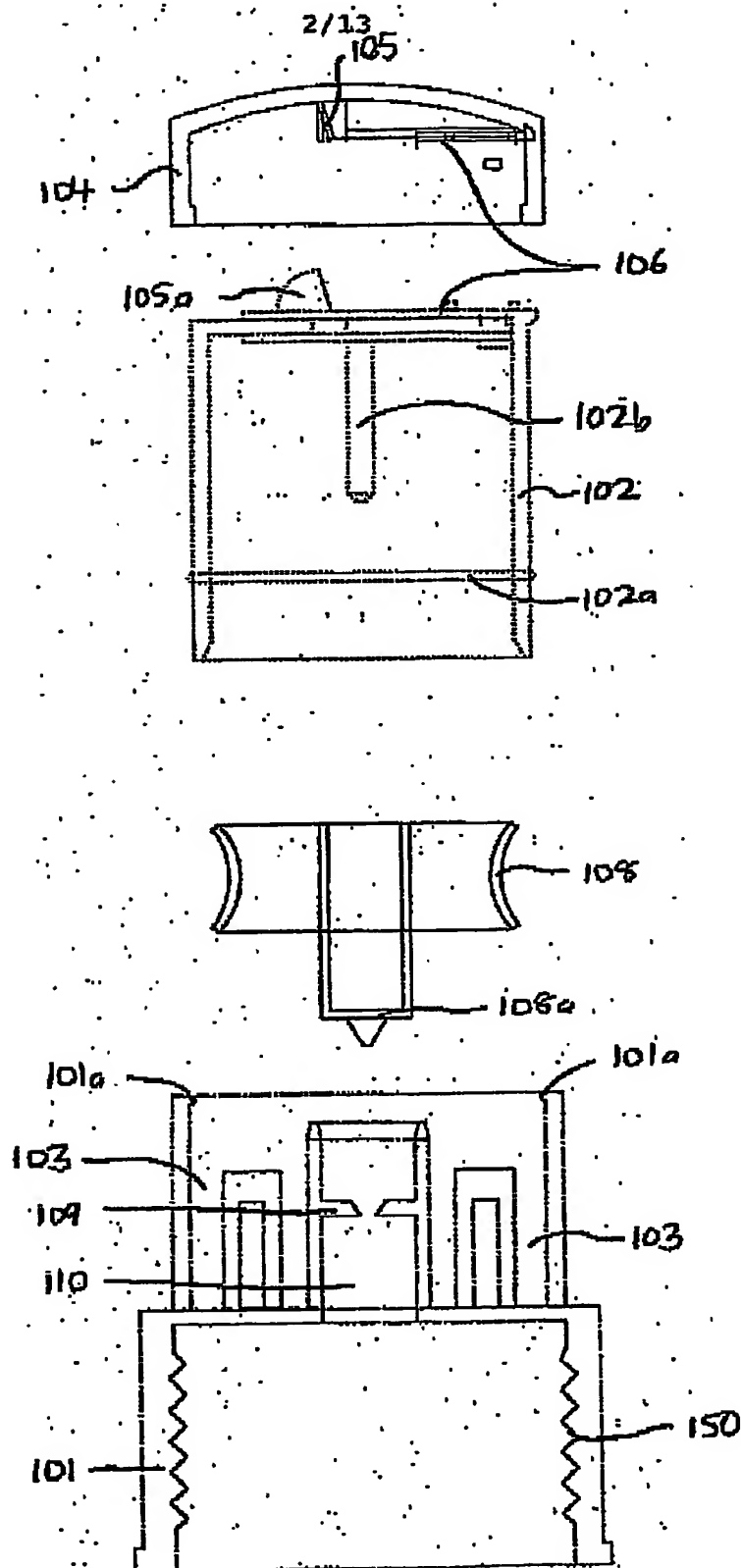
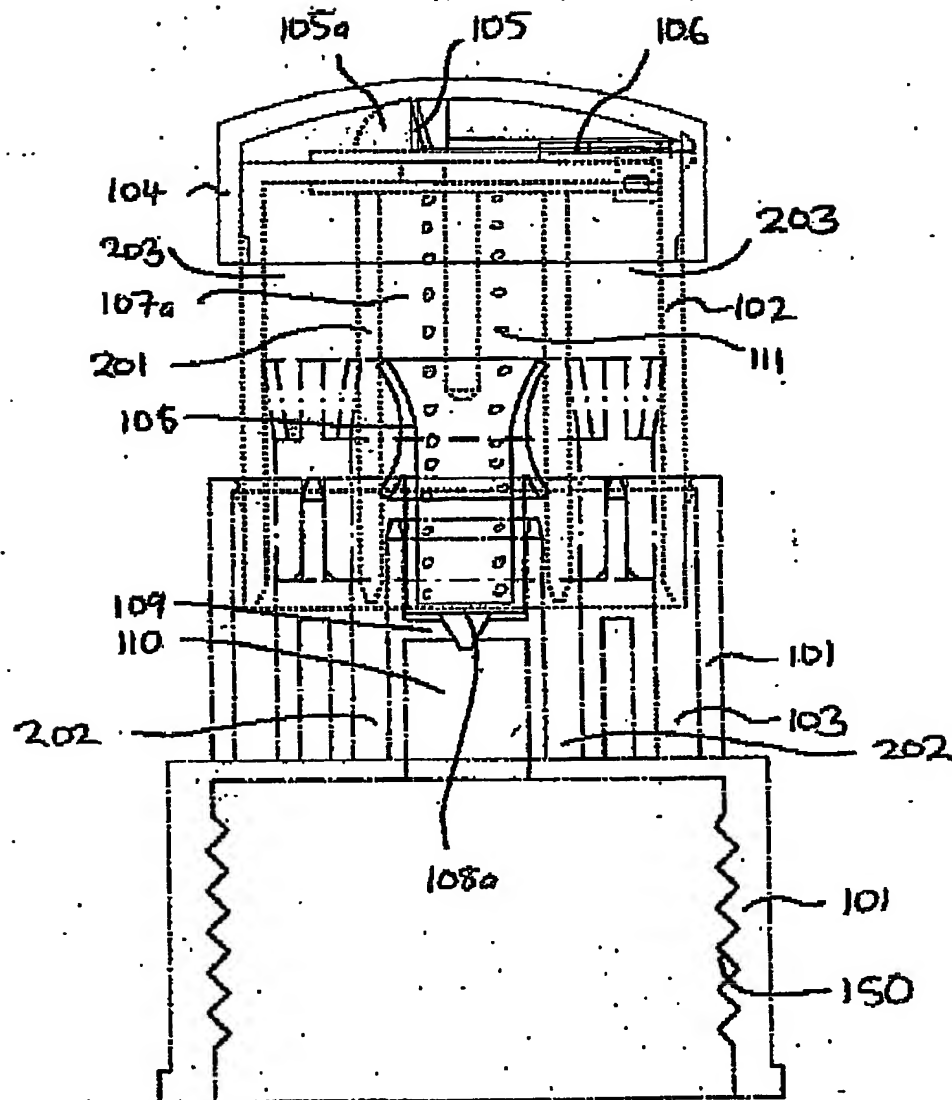
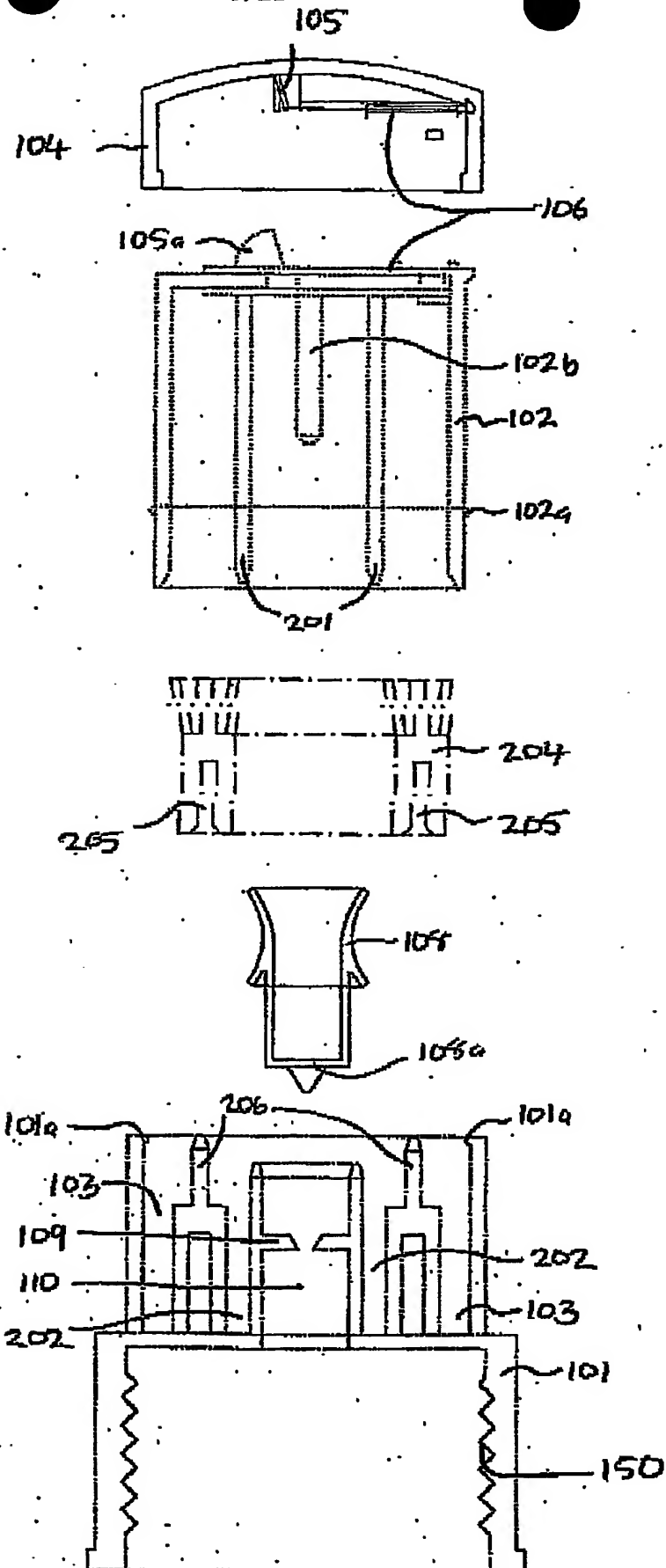


Figure 1B

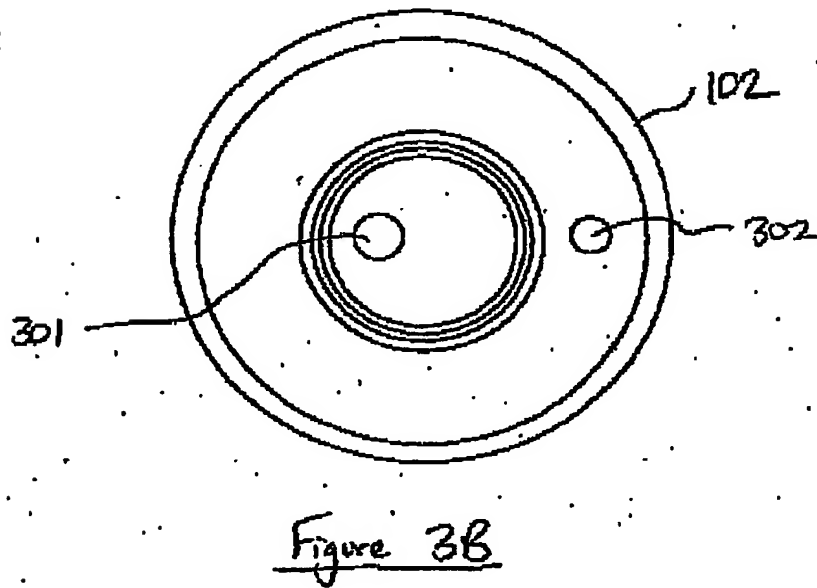
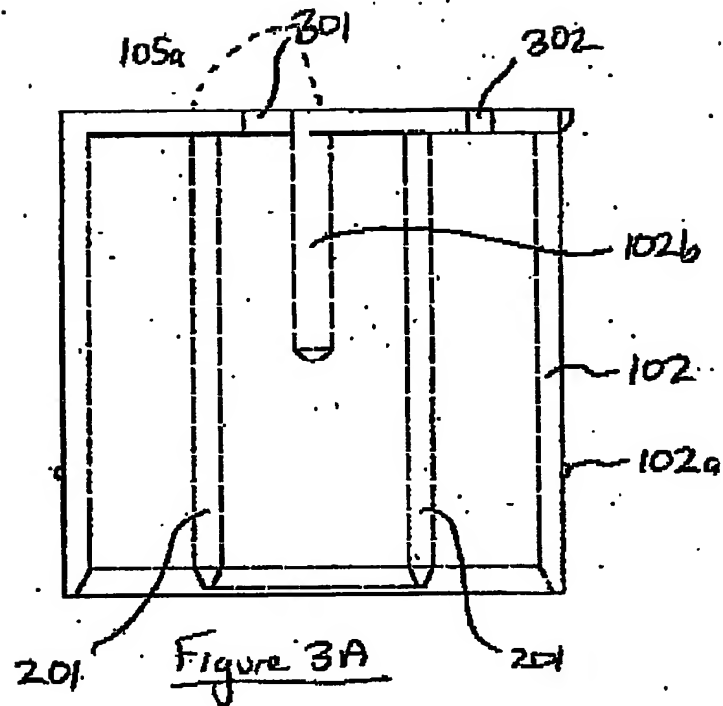
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Figure 2A

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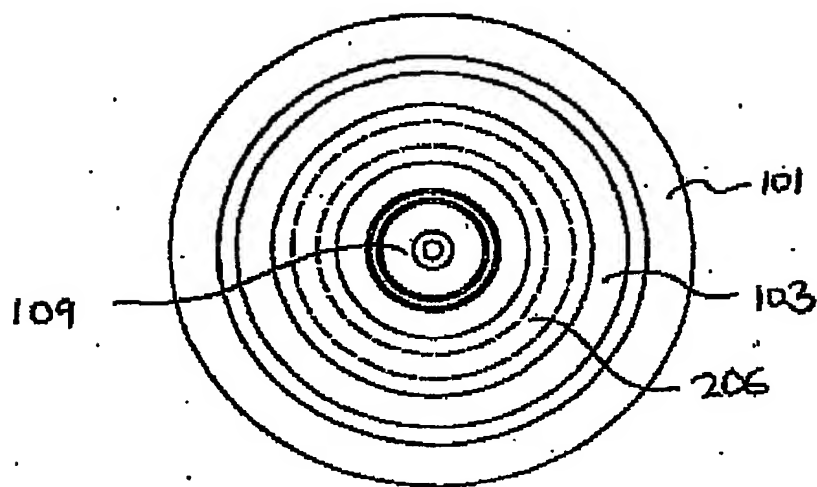


Figure 4

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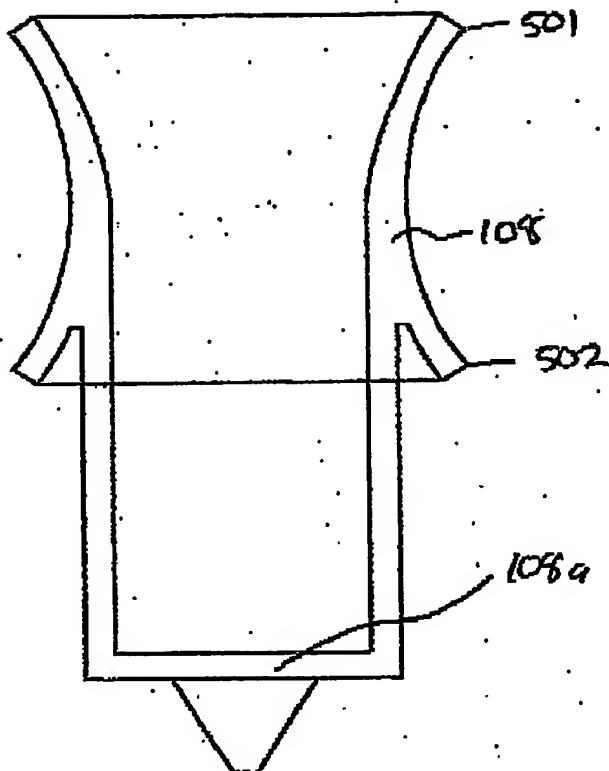


Figure 5A

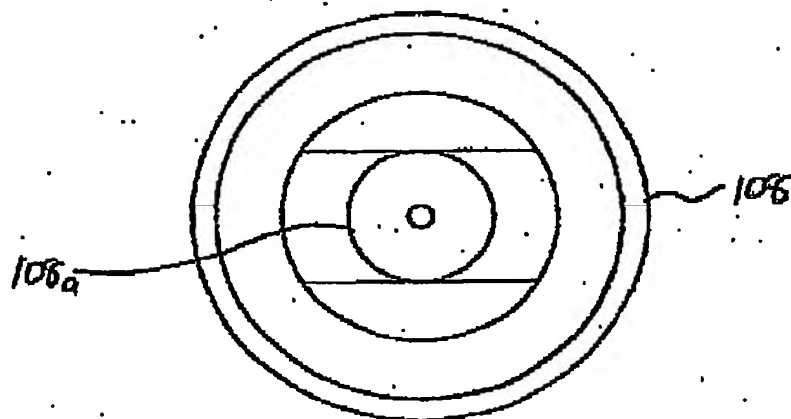


Figure 5B

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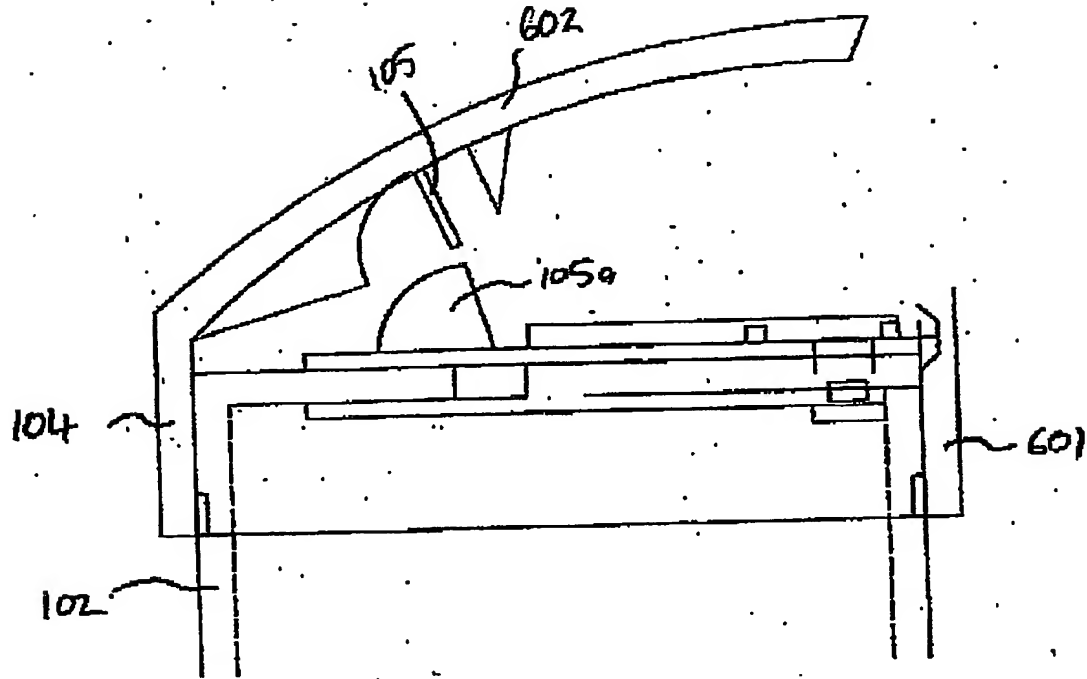


Figure 6A

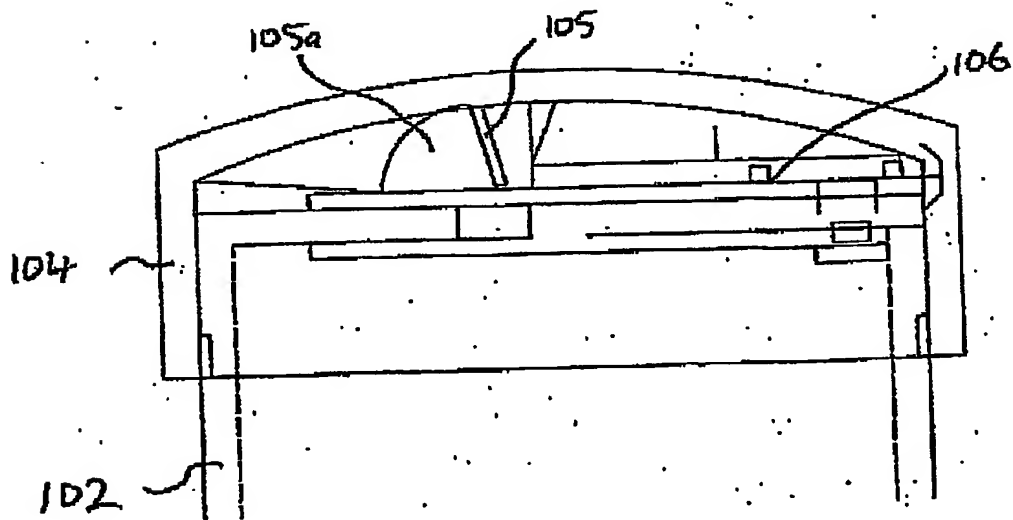
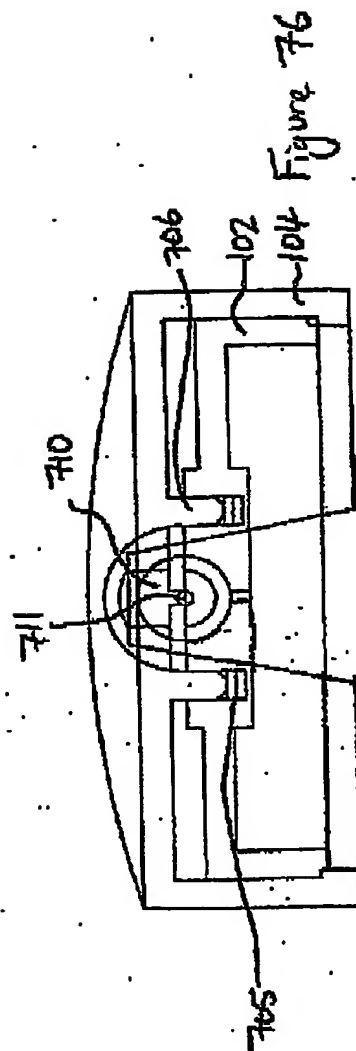
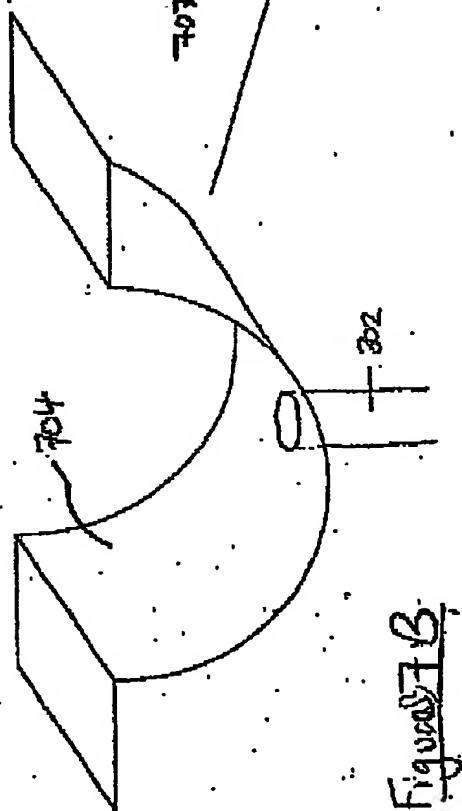
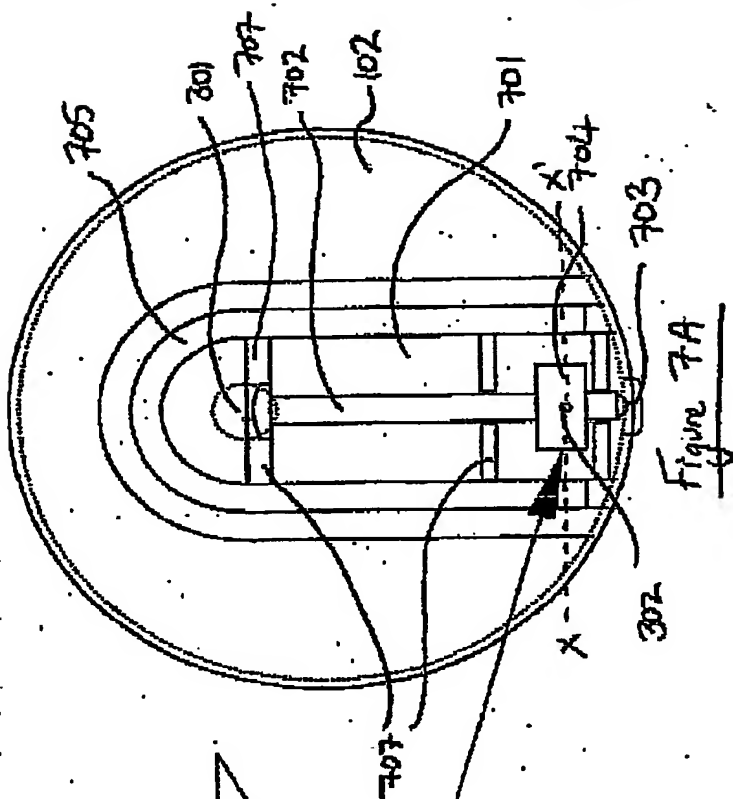


Figure 6B

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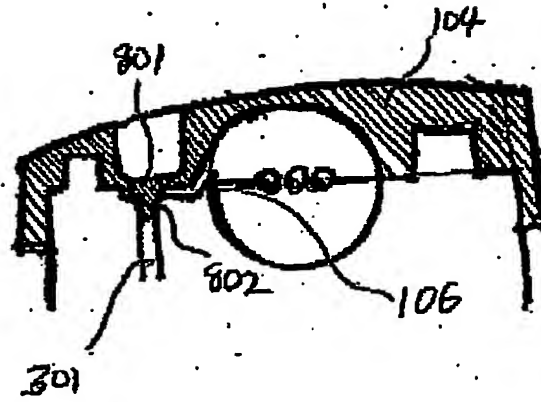


Figure 8

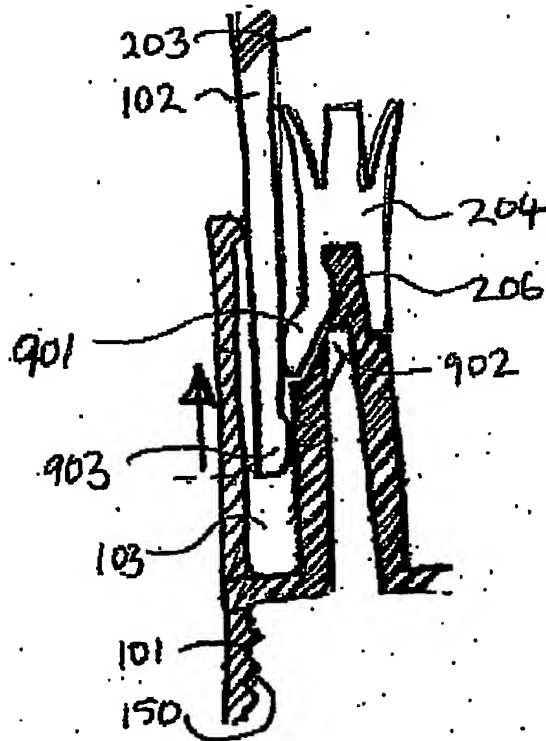


Figure 9A

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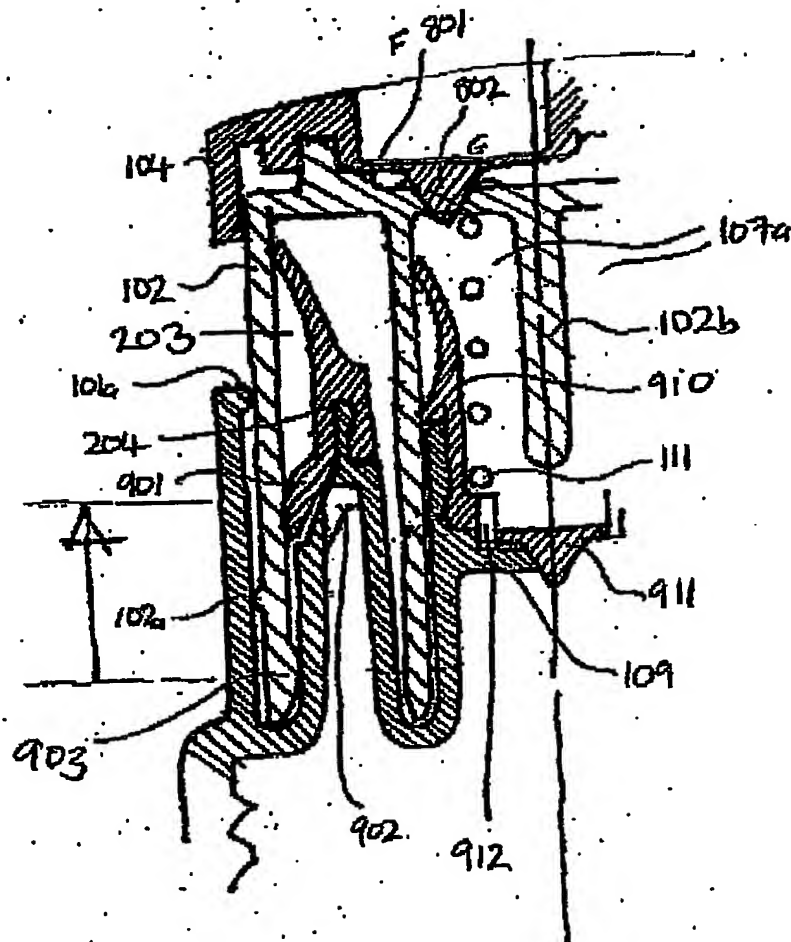


Figure 9B

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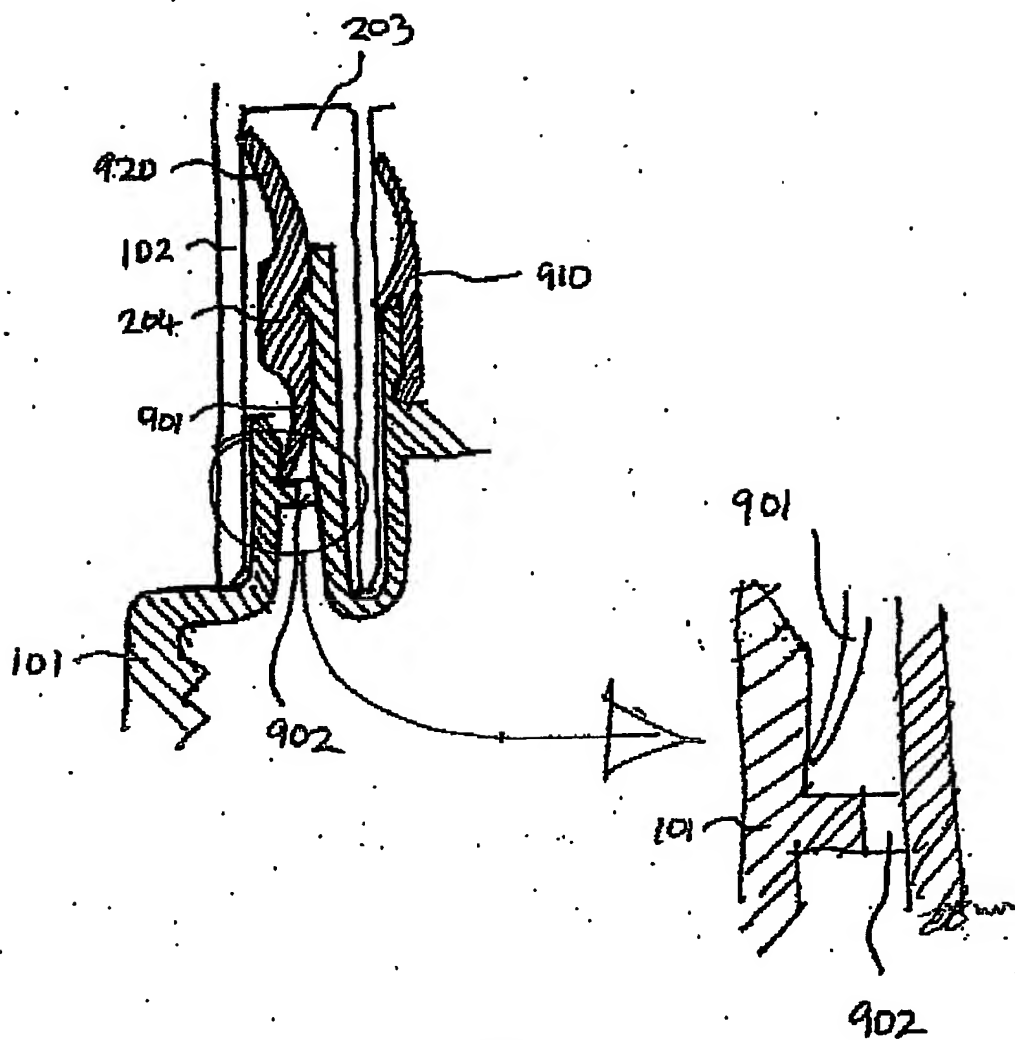


Figure 9C

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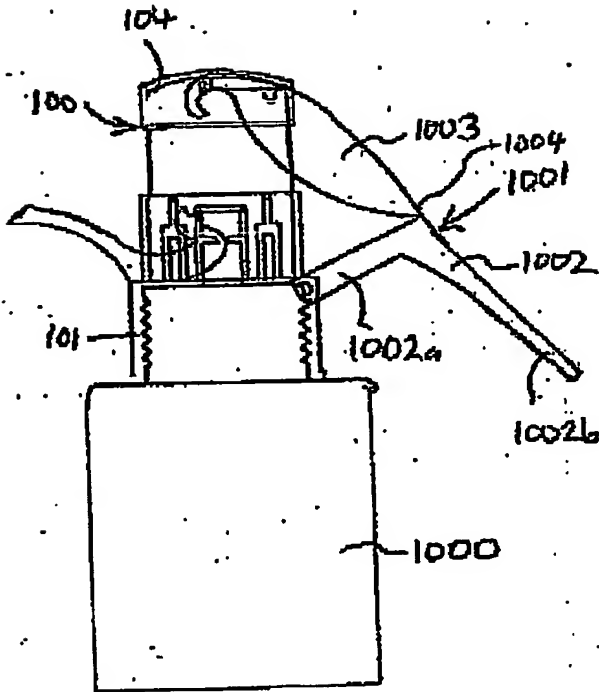


Figure 10A

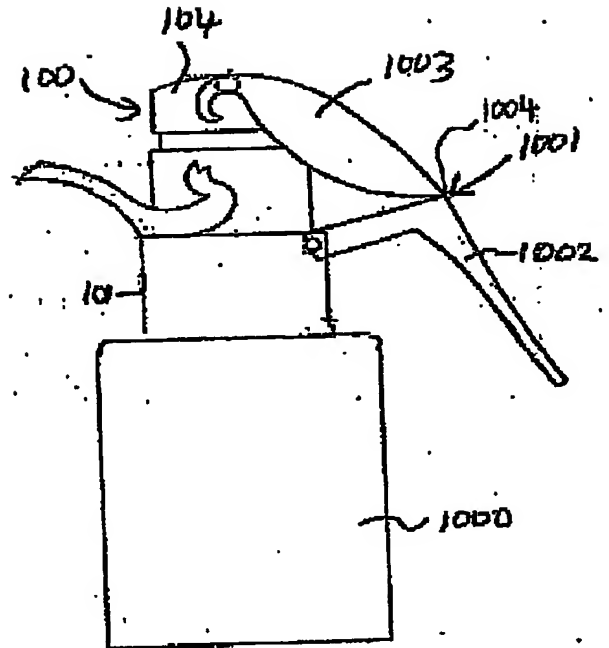


Figure 10B

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